

WIGGLE

THE
VERSATILE
SPONGE

VERA FAGERBERG 2026

ACEX16 Bachelor's thesis Architecture and Engineering

Chalmers University of Technology

In collaboration with Elvira Söderbärg, Freya Moh, Ruben Bång Brunström



The first iteration of the project

This bachelor project is based on the program of the student design competition held by the Acoustical Society of America and the Newman Student Award Fund. It is an interdisciplinary project in collaboration between students from the programs Architecture and Engineering and Sound and Vibration.

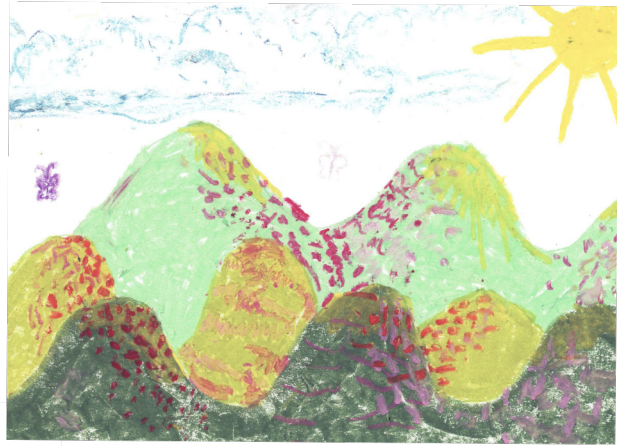
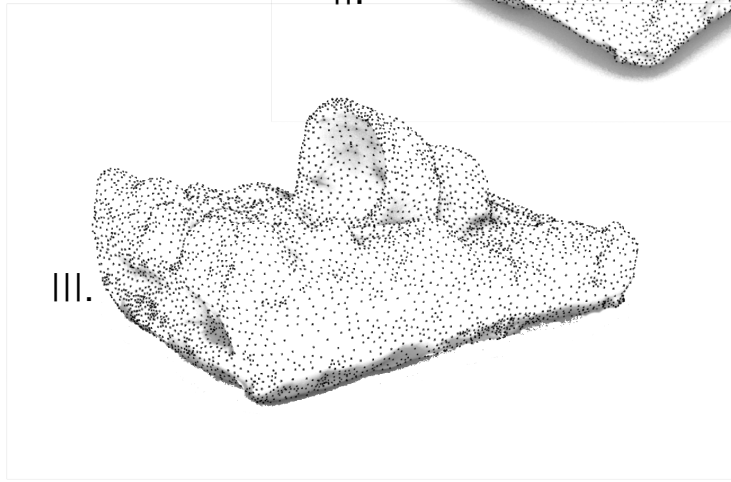
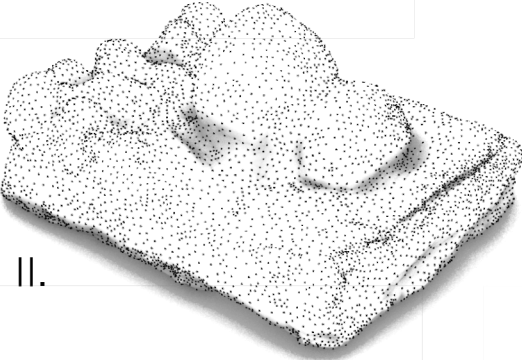
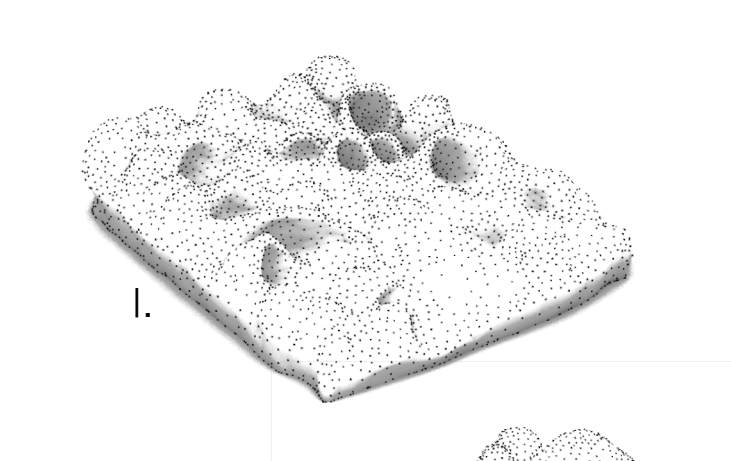
Wiggle is a multipurpose pavilion designed to host a variety of performances. Beyond its role as a venue, it serves as a public park for the community, especially beneficial for the nearby residents. A core ambition of Wiggle is the island seating arrangement. Rather than having one continuous roof, the seating areas are distributed across the landscape like individual sound islands. The architectural vision is to create a fairytale-like, wavy landscape that gradually absorbs highway noise while protecting the nearby residential area. To achieve this, the project transforms the ground into a series of hills. Together they serve as an acoustic and architectural labyrinth where intruding sound is lost on its way, while also providing integrated seating for the audience.

The first iteration of the project was to make a three meters long section drawing with oil pastels, where different potential concepts of the venue were explored. This drawing made a huge impact on the end result by guiding the work with colors and shapes. It was the birth of the whimsical idiom.

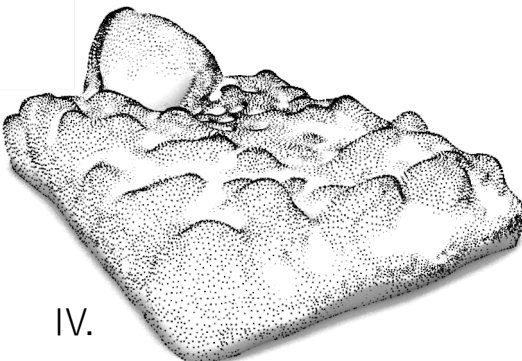


One of the first things we did was to place the stage. We decided to place it in the northwest end of the site and directed towards the southeast, for it to be close to the river and far from noise sources while also avoiding direct sunlight during evening performances.

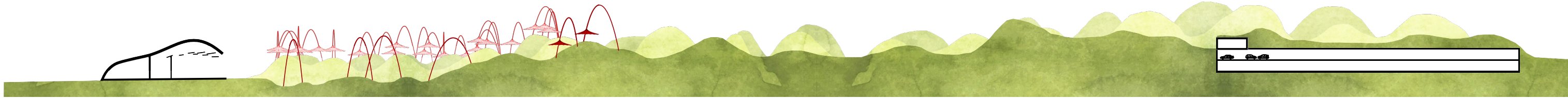
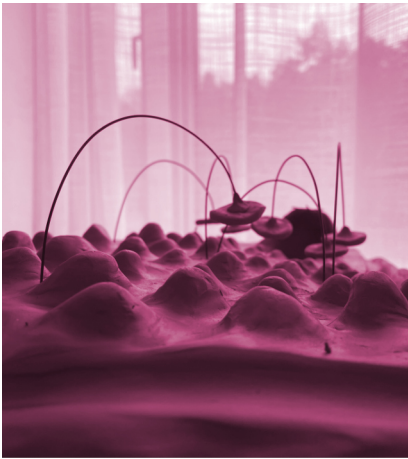
The chosen location is at the lowest point of the site, which would facilitate the work of ensuring good visibility. During our first iteration and the analysis of the site, we realized that the landscape was not as sloping as we would like to ensure great sight for all visitors. Therefore, we started to experiment by partly burying the stage and by building artificial sloping, which finally led to the idea of a hill landscape covering the concert venue. It wasn't until we got to physically model in clay that we realized that we could also let the hills perform acoustically. That's where the idea of the acoustic sponge emerged, and we later covered the whole site with hills. The clay model also helped us understand the size and number of roofs needed for the required 3000 seatings. At first, we only had six roofs, but eventually we ended up needing around 50 roofs.



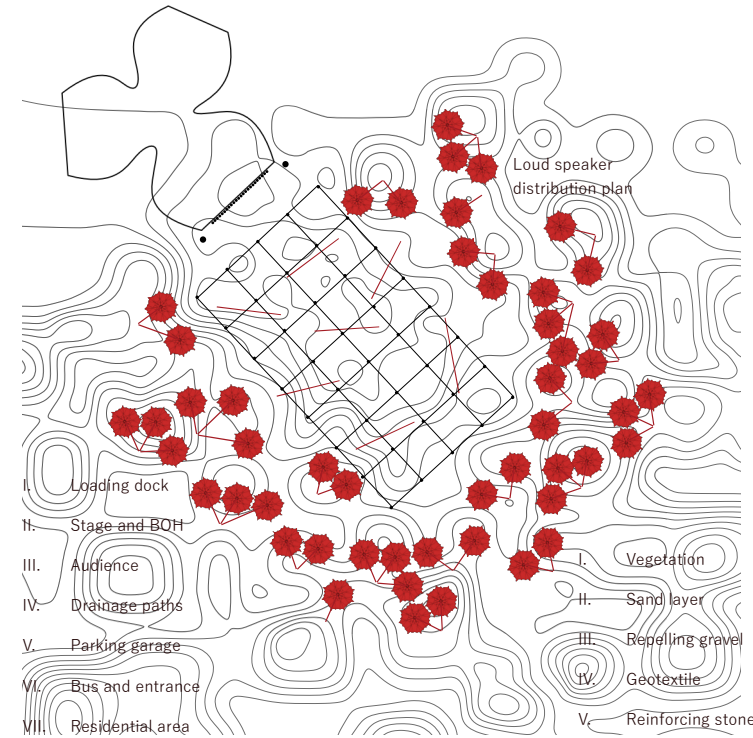
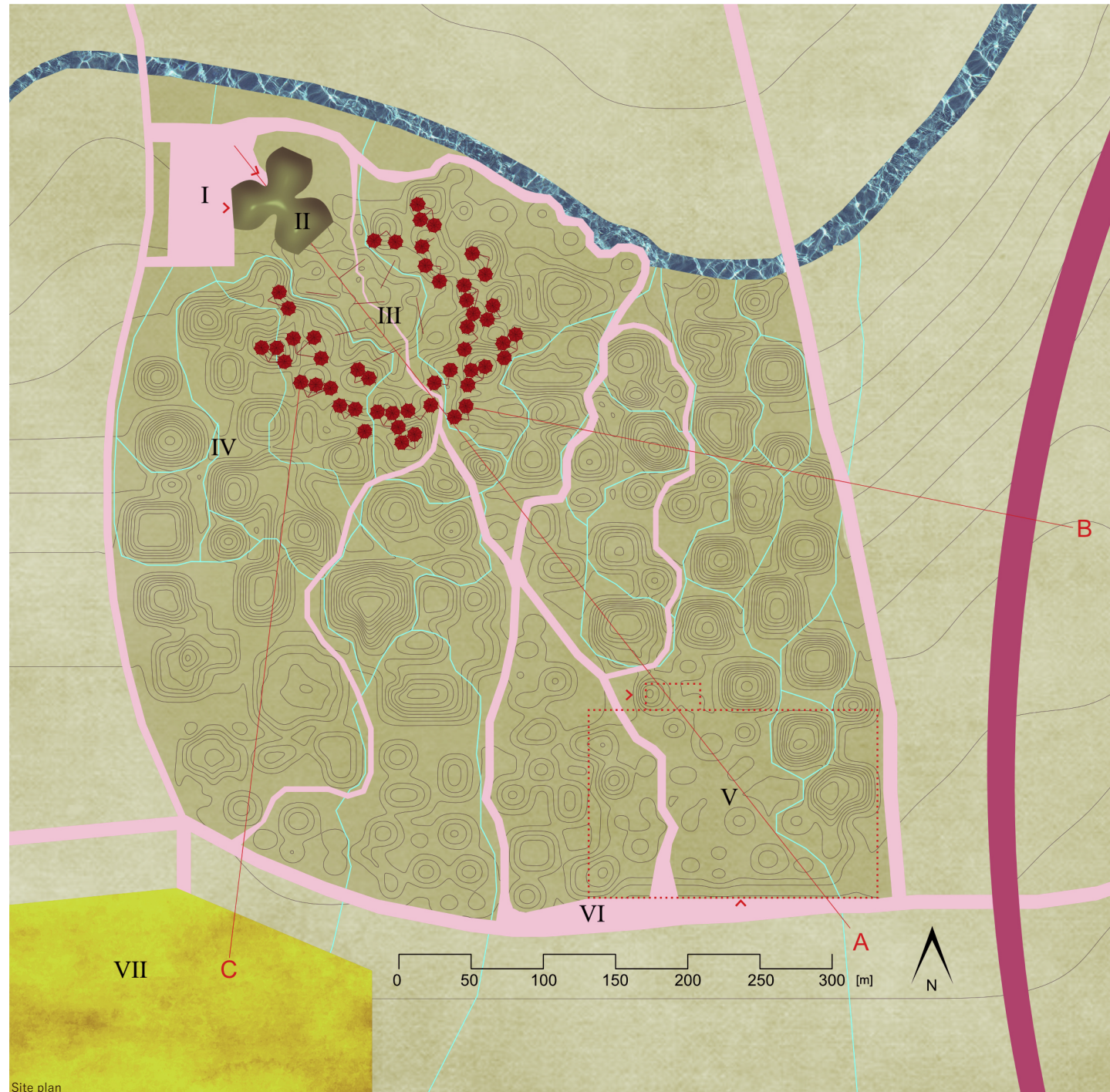
- I. Sketch model of the lawn
- II. Sketch model of back of house
- III. Sketch model of the stage
- IV. Sketch model of the whole pavilion



Clay models with integrated roofs



Section A-A

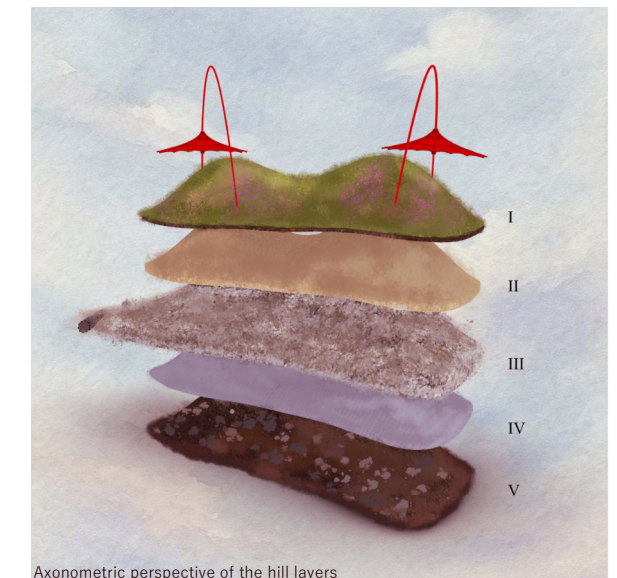


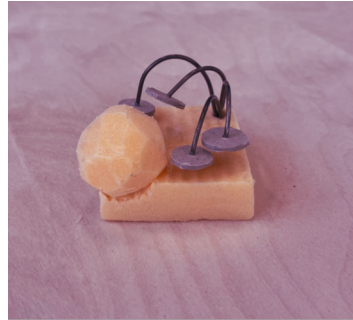
The site accommodates 10,000 visitors on the lawn and 3,000 under 50 sheltered roofs for seating. The lawn and sheltered areas are dimensioned to provide 0.9 m² respectively 1 m² per person. To maintain the acoustic phenomenon that all sounds originate from the stage, the amplitude and delay of the loudspeaker signals in relation to the direct sound from the loudspeaker at the stage are chosen to represent a first strong reflection. The stage is positioned away from residential areas to make noise control easier. The lawn area is supplied with sound from the loudspeakers in the front of the stage as well as from loudspeakers attached to the wired grid spanning between the arches over the lawn.

All desired pathways will be paved with drainage and all seating will be organised on benches thus keeping the flower beds and vegetation free from people walking all over. Some pathways are wide enough for emergency vehicles. The hills are gradually lower towards the stage to ensure sightlines from the back and for the venue to progressively open as you approach the stage, promoting the feeling of an arena.

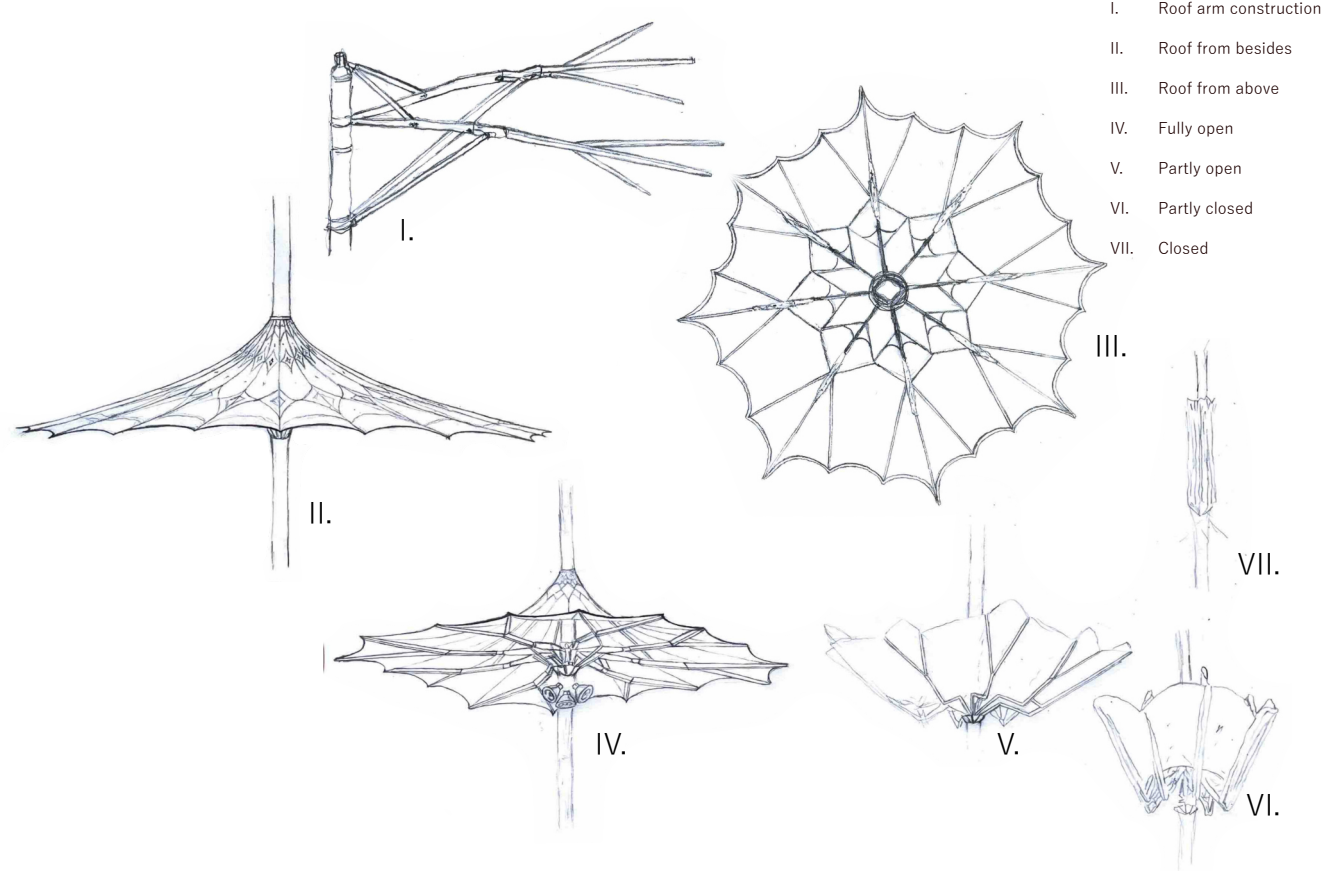
The hills are intended to have several functions. Primarily, they are together designed to form an absorbent sponge that soaks up the noise from the interstate to the stage and from the stage to the residential area. They also create the possibility of integrated seating and a divided audience and are beneficial for ensuring a satisfactory view by creating various levels. In addition, they create an interesting, winding path to the stage that could be an experience itself. The durable, absorbent plants, such as heather, create splashes of color and life in the landscape. They reinforce the feeling of being in a park and align with the intended playfulness.

The hills create challenges for visibility, but on the other hand they reinforce the experience of being there in a smaller group on your own island. The venue offers diversity in spots with different qualities everywhere. It is a concert pavilion you can return to many times without ever receiving the same experience. Together with the fact that the roofs have speakers close to ground level, it can be argued that it is the individual participation and the sound that is important, rather than seeing the stage perfectly from all locations.





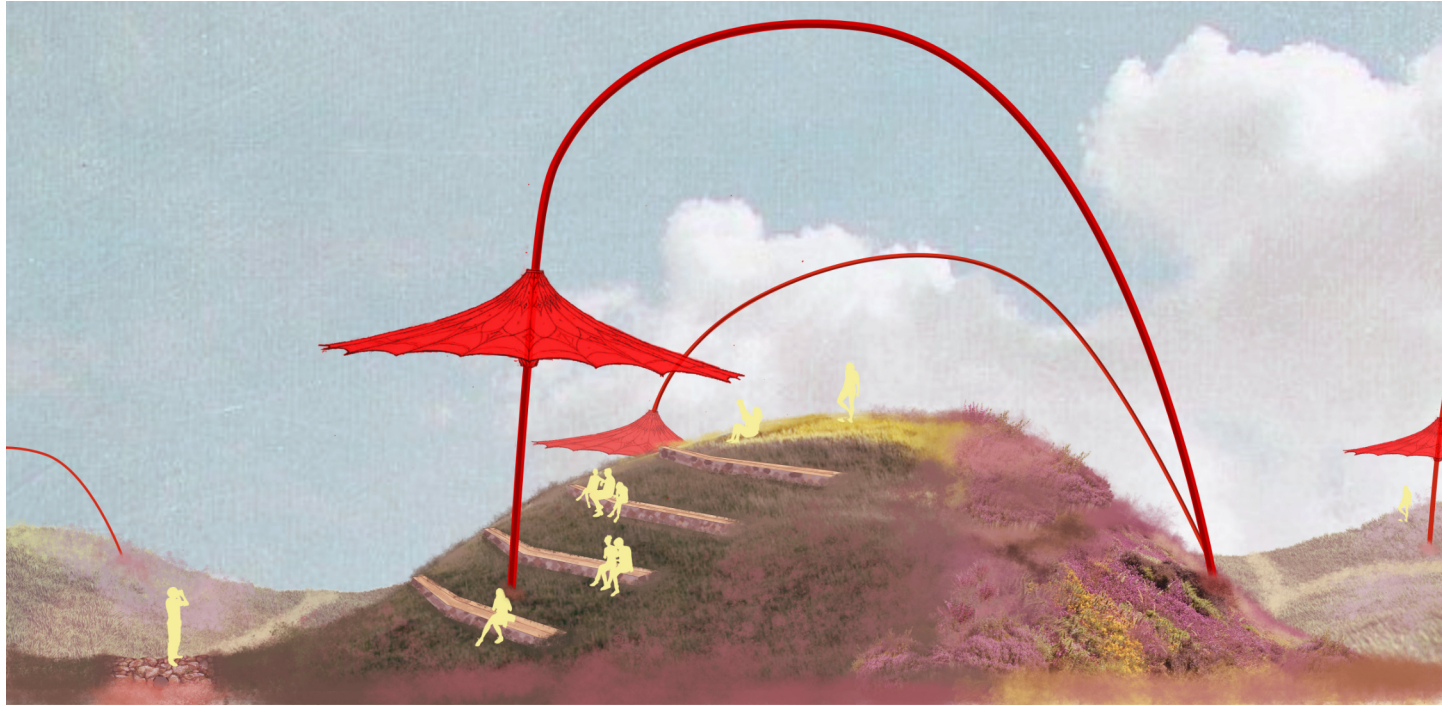
The first concept model of the roofs



We knew early that we wanted to split the seated audience up, and when we calculated how many of these circular roofs would be needed for 3000 members to keep them a reasonable size, we were quite shocked when we counted to 50. One of our main goals was to keep the area right in front of the stage clean and just for the standing audience. It was natural to place the roofs on higher hills framing the lawn in and enclosing the area as well as not obstructing the visibility. To still guarantee a pleasing visibility for the seated visitors, the roofs are placed on higher hills which both enclose the area and create platforms. The arrangement is destined to make the venue as arena-like as possible without including any substantial walls.

We had a consistent vision of creating flexibility for the pavilion. In an early stage, this was to be achieved by having the roofs pivot around an axis. Instead, we chose to make the roofs fixed and foldable. Flexibility refers to the type of concert and the number of visitors. For a long time, the idea was to have a floating roof. The arch would be attached at one end, and the roof would hang freely at the other. This would both ease the work with ensuring great sight for the audience and creating an airier atmosphere. The reason we abandoned this idea and attached the both ends of the arch was because we thought it was more important to maintain the slenderness and elegance of the construction than for the roofs to float, and the expression was intact.





Acoustically, the interstate was modeled as a set of discrete point sources in order to approximate a line source. For each source position and octave band, the propagation loss was calculated as the difference between the sound pressure level at the road and the level at a receiver. This was done for both a free field case and a case including the surrounding hills.

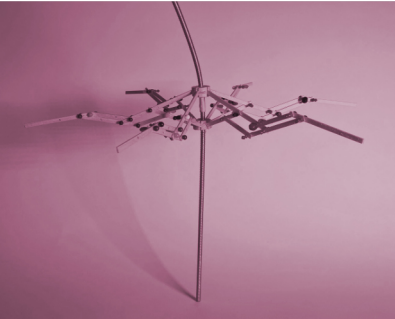
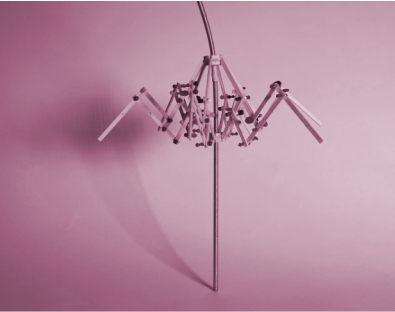
After summing the contributions from all source positions, the insertion loss was obtained as the difference between the total free-field level and the total level with terrain. The resulting graphs contain distance attenuation, atmospheric absorption, and the insertion loss provided by the hills. Thus, the acoustic sponge is constructed, enabling a pavilion free from both noise and solid barriers.



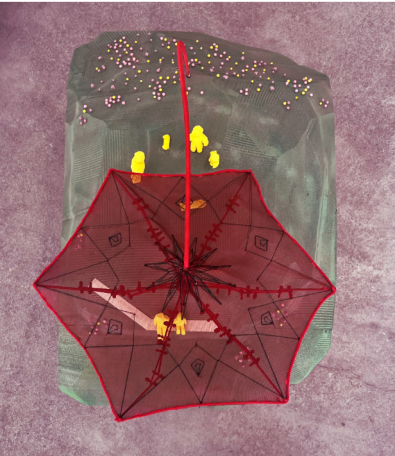
The process that left the biggest impact on the result is the desire to stick to the color, shape, and playfulness. The red color of the roofs is expressive and popping and does well in creating contrast against greenery. The romantic vision of planting flowers and letting the whole area be a field enables a play with colors and variable expressions according to seasons and areas of the site. The idea is that our roof structures, in combination with the many hills, could become a colorful landmark visible from the surrounding highways, and invite guests to a stroll in the park as well as attending a concert.

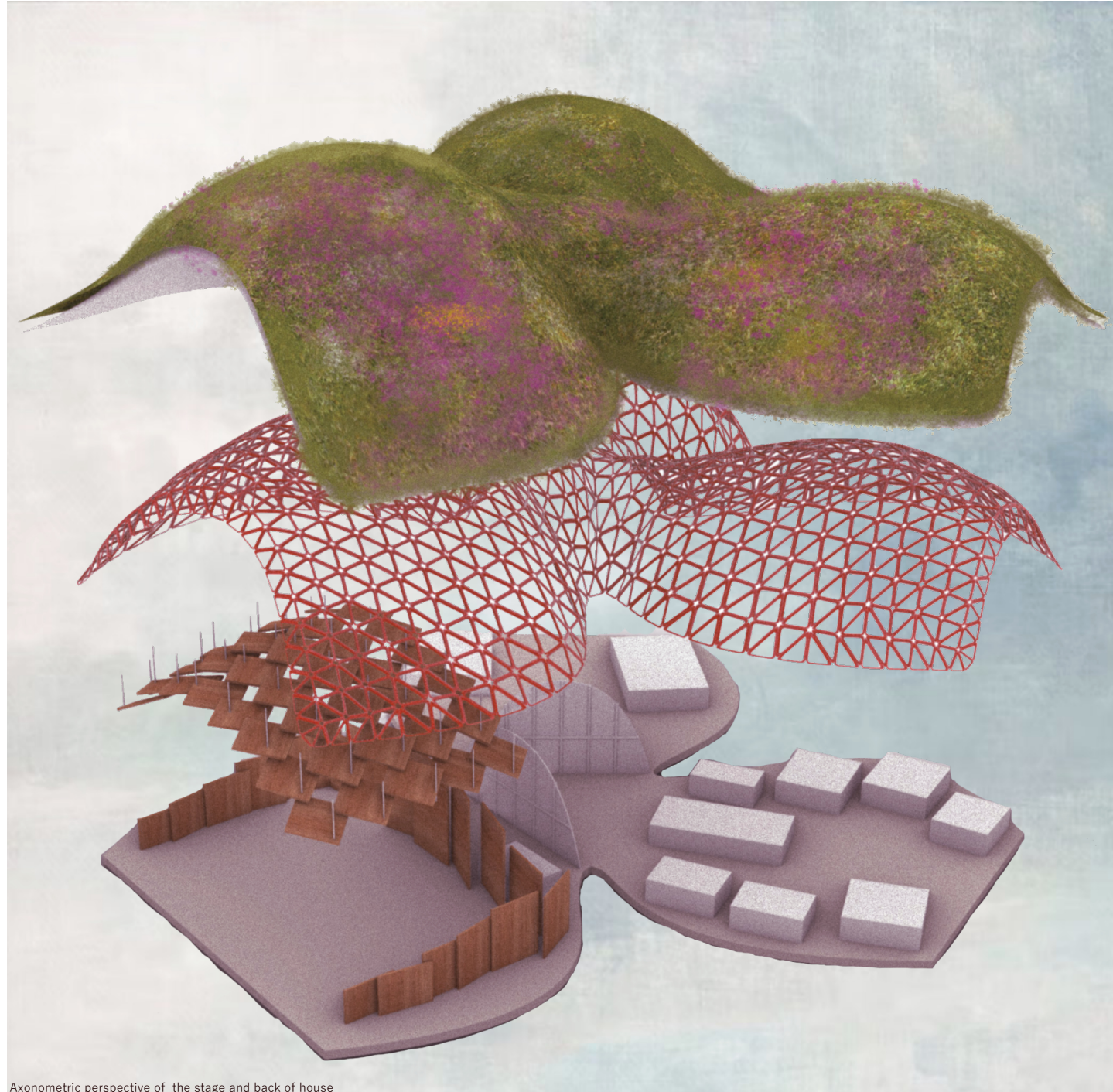
The roofs are intended to function as light weather protection, support loudspeakers, create intimate spheres, and be sculptural. In addition, they act as absorbers towards the residential area, as seen in section C-C. They are foldable and made of fabric and are therefore likened to large red flowers where they stand in clusters in the field.

The aim is to let the areas under roof be permeable and airy, and there are therefore no solid walls next to the seated audience. This is to create a loose and welcoming landscape that functions as a public park as well as a concert pavilion. We wanted the place to be usable even when there is no concert, which is one of the reasons behind the island seating concept. Different companies will be able to sit under different roofs and the risk of the pavilion feeling like an abandoned arena while not hosting any performances minimizes, since the stage building is so discreet.

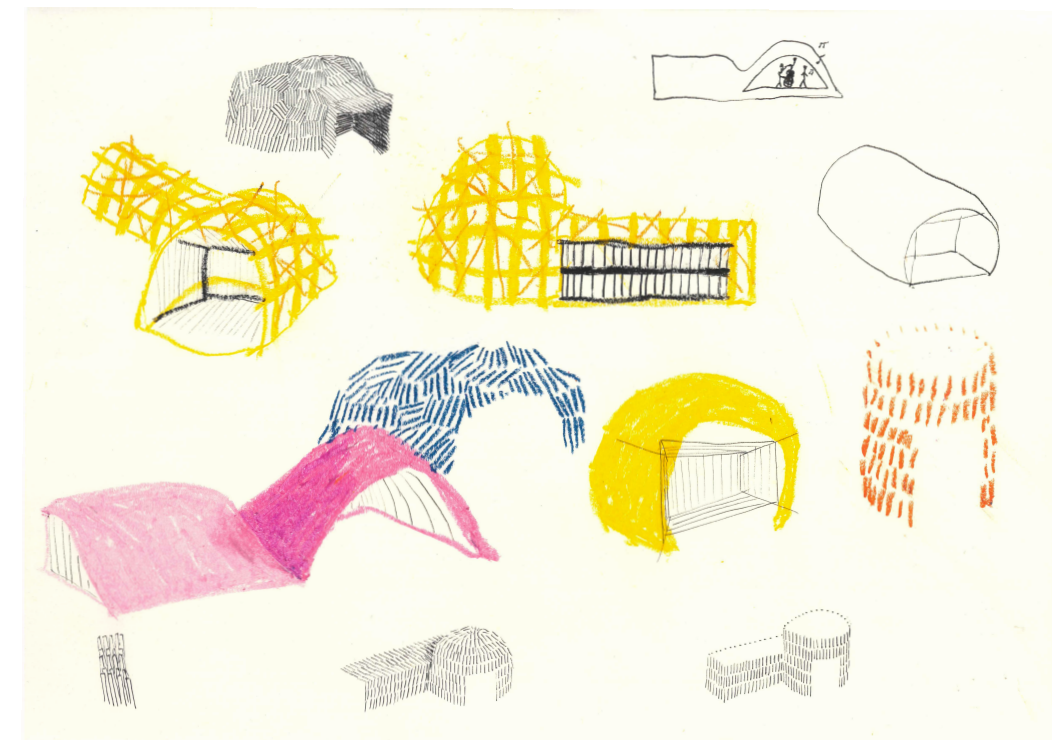


Model of a roof and its position on a platform hill





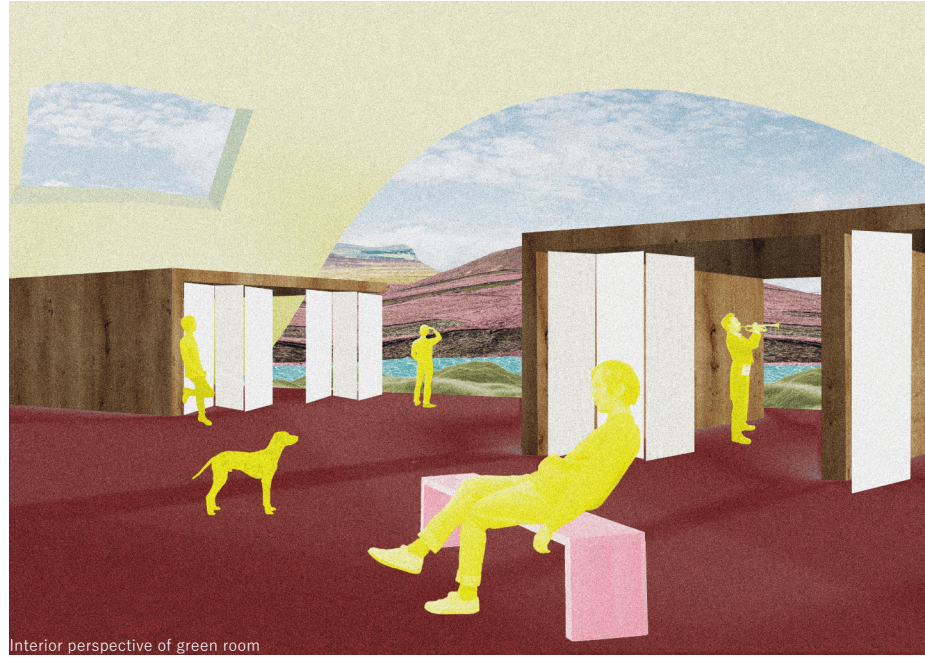
Axonometric perspective of the stage and back of house



Early sketches of the stage building

The stage design was developed relatively late in the process. We thought for a long time about whether the stage should blend in with the landscape or form a contrast. We ended up making a stage that blends into the landscape, as part of the hills. This was to let the red roofs stand out as the most remarkable elements. There are also acoustic advantages to this alternative as the thick sedum roof contributes with absorption.

The stage building seems like a continuation of the hill landscape in three composite sections. Inside, one part is for the stage, one for technology and storage, and one for living areas. In the large living room, there is a window with a view of the river. By covering the building with soil, it aligns with the versatility of the project. Depending on desired expression, different types of vegetation can be planted on the roof in a play with textures, patterns, and colors.



Interior perspective of green room



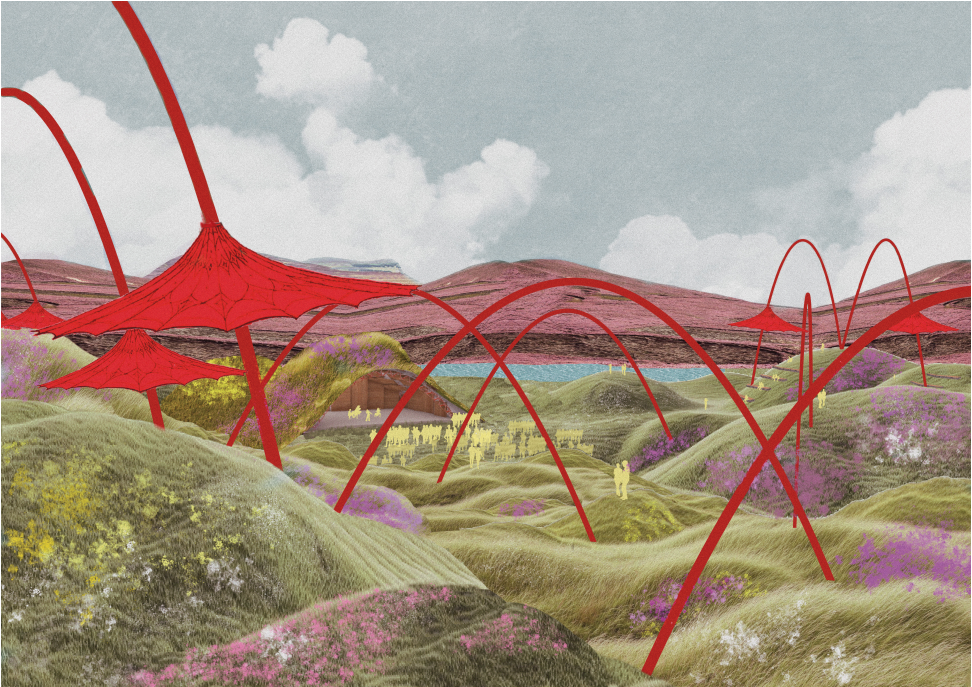
Interior perspective of back of house



Inspired by the airport architecture, the concept of the stage and back of house building is to create a single large room with functions organized in smaller boxes, maintaining the feeling of always being within the larger space. The building is designed on a single level, allowing efficient movement. Two isolating foldable walls are separating the stage, the loading area, and the quieter back of house functions, enabling concerts and loading to take place simultaneously.

The floor plan grew from a flow chart with squares. While puzzling, we realized that we could use the same concept for the actual floor plan; to place boxes of functions under a freely formed roof. All the boxes have huge windows towards the indoor living areas and the larger windows in the building shell but can be sealed with curtains for privacy.

These last few months have taught me how to approach a project. Since we started to work artistically and by starting with analyzing phenomena and letting the architecture grow gradually rather than starting by placing doors on a floor plan, I feel like my perception of this profession changed drastically. In this bachelor's project, the initial sketches with oil pastels really set a mark that lasted throughout the course. It feels liberating to finally be able to set my own programs to the projects. I've come to the stage where I'm steady enough to not always need detailed instructions, and I can confidently set up my own list of intended visualizations for my works. I also recently discovered the satisfaction of being able to integrate the technical parts of my education naturally, and to effortlessly combine all my knowledge in the work I am doing. By interdisciplinary collaboration with the master students of the sound and vibration program, the result of this project felt truly multifaceted. I finally feel like the architecture and engineering student that I have now been for three whole years.



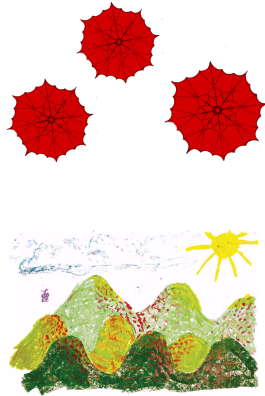
By: Ruben Bång Brunström, Freya Moh, Elvira Söderbång | Chalmers University of Technology | Advisors: Wolfgang Kropp, Morten Lund, Peter Christensson And Vera

WIGGLE

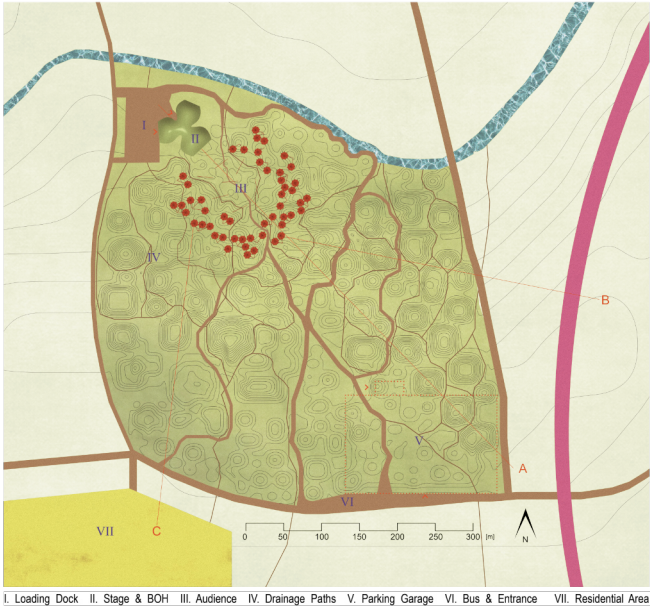
The Wiggle is a multipurpose pavilion designed to host a variety of performances. Beyond its role as a venue, it serves as a public park for the community, especially beneficial for the nearby residents.

A core ambition of The Wiggle is the island seating arrangement, inspired by the Scandinavian archipelago. Rather than having one continuous roof, the seating areas are distributed across the landscape like individual sound islands.

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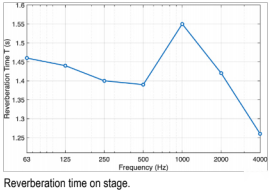


Section A: Section of the site.



STAGE

The stage layout shown is dimensioned for the full 100 orchestra members accompanied by 150 choir members. The material finishes inside the stage consists of a reflective wooden ceiling, plywood interior walls and a wooden floor. In the calculations the absorption of the performers is included. The stage is shaped to keep reflections inside the volume and preserve the energy. In the case of touring acts the panels will be rotated to dry out the room acoustics.

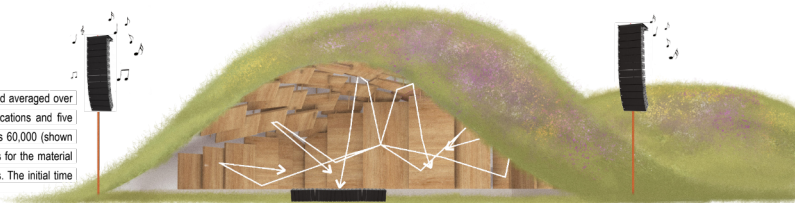


Reverberation time on stage.

LAWN

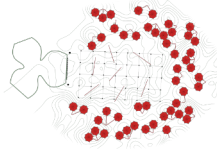
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Ray tracing was performed in COMSOL and averaged over two configurations with different source locations and five receiver positions. The number of rays was 60,000 (shown with six rays). Absorption coefficient curves for the material were obtained from JCW Acoustic Supplies. The initial time delay gap is 27 milliseconds.

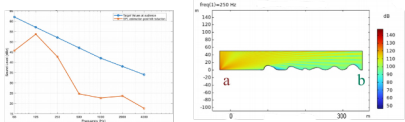


SITEPLAN

The site accommodates 10,000 visitors on the lawn and 3,000 under 50 sheltered pavilions for seating. The lawn and sheltered areas are dimensioned to provide 0.9 m² respectively 1 m² per person. To maintain the acoustic phenomenon that all sounds originate from the stage, the amplitude and delay of the loudspeaker signals in relation to the direct sound from the loudspeaker at the stage are chosen to represent a first strong reflection. The stage is positioned away from residential areas to make noise control easier. The lawn area is supplied with sound from the loudspeakers in the front of the stage as well as from loudspeakers on the arches spanning over the lawn. Some pathways are wide enough for emergency vehicles. All desired pathways will be paved with drainage and all seating will be organised on benches thus keeping the flower beds and vegetation free from people walking all over. The hills are gradually lower towards the stage to ensure sightlines from the back.

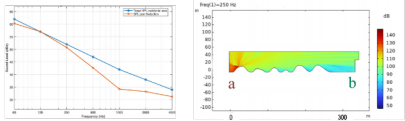


Placement of roofs and loudspeakers, 15 m apart, 12 m height, on lawn area, 9000 sqm standing audience and 3000 sqm covered audience, 95 dbz uniform distribution.



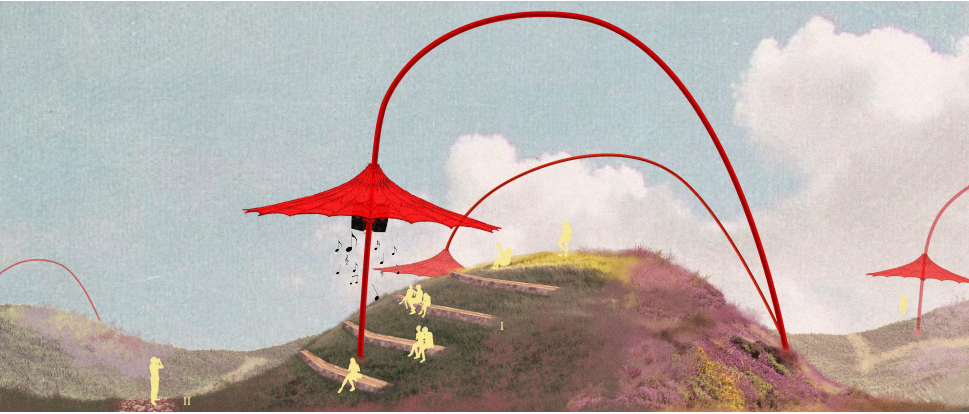
Target versus estimated SPL at closest audience point from interstate.

Section B:
a. Interstate highway
b. Audience closest to interstate



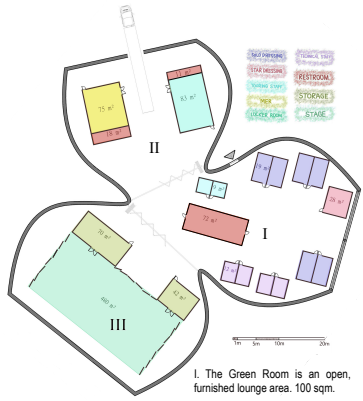
Target versus estimated SPL at the residential area.

Section C:
a. Speaker closest to residential area
b. Residential area



FLOOR PLAN

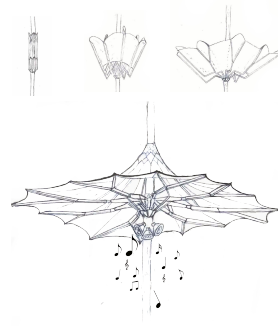
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I. The Green Room is an open, furnished lounge area, 100 sqm.
II. Any remaining floor area is utilized as supplementary storage space 450 sqm.
III. Stage dimensions 30 m width, 16 m depth, 11 m top height

ROOFS

The roofs are inspired by the nyctinasty of a flower and the mechanics of an umbrella. The fabric was selected as the ideal material to merge technical performance with the aesthetic vision.



Perspective on one of the hills. Loudspeakers are placed underneath the roof enabling an intimate listening experience while protecting the residential area. The back of the hill, where fewer people sit, is covered in absorbing heather. The hill is constructed in layers, with grass, geotextile, water repelling gravel, drainage and stabilizing reinforcement to prevent dislocation.

I. The seating is constructed from gabions, with a wooden bench on top. In addition to providing seating, these gabions function as acoustic absorbers.
II. French drains are integrated to manage drainage and direct runoff toward the river. These drains match the gabions in style and acoustical function.



STRUCTURE

IV. A thick sedum roof covered in vegetation creates an absorbing layer.
III. Form-found shell structure to a triangular truss enabling suspension of acoustical panel and tech systems.
II. Adjustable reflective wood panels.
I. The three stage hills are separated with an absorbing foldable gate.

